



*Applied Physics  
Optics Seminar*

# **Solution-Processed, Large-Area, Physically Flexible Infrared Optoelectronics:**

1000-2000 nm Tunable Electroluminescence, Modulation, and Detection from Colloidal Quantum Dots

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Solution-synthesized nanocrystalline semiconductor quantum dots can be spin- or spray-coated onto a diversity of substrates: rigid or flexible; smooth or rough; flat or curved; inorganic or organic, including biological; crystalline or amorphous; conducting, semiconducting, or insulating.

We synthesize quantum dots in solution and spin-cast from organic solvents such as toluene, chloroform, or THF. We tune PbS quantum dot nanocrystal diameter from 2 to 10 nm with ~ atomic monolayer control over diameter. Tunability via the quantum size effect allows emissions from 1000 to 2000 nm with inhomogeneously-broadened linewidths under 100 nm. Control over organic ligands on dots' surfaces is necessary to achieve high quantum efficiency and to avoid aggregation in solution and films. To date we have demonstrated experimentally:

- Electroluminescent devices on a transparent substrate with up to 3% quantum efficiency;
- Photodetection with a quantum efficiency of about 2%;
- Controllable two-colour emission based on combinations of families of dots in mixed or separate layers;
- Electric field-induced absorption modulation 600-2000 nm;
- Third-order resonant nonlinear optical response tunable across the communications spectrum and with ~ 10 ps recovery times.

We review our progress towards creating a suite of technologies to unite optoelectronics with passive optics, silicon electronics, microwave electronics, and large-area polymer electronics.

### ***Biography:***

*In 2003 Ted Sargent was named "one of the world's top young innovators" by MIT's Technology Review. In 2002 he was honoured by the Canadian Institute for Advanced Research as one of Canada's top twenty researchers under age forty. In 2002 he won the Outstanding Engineer Award of the Institute of Electrical and Electronics Engineers (IEEE) of Canada. He was awarded a Canada Research Chair at the University of Toronto in 2000. Ted Sargent's doctoral research on the lateral current injection laser won him the 1999 NSERC Silver Medal. He received the B.Sc.Eng. (Engineering Physics) from Queen's University in 1995 and the Ph.D. in Electrical and Computer Engineering (Photonics) from the University of Toronto in 1998. More information is available at: <http://light.utoronto.ca/tsargent>*

***Wednesday, July 21, 2004.***

***11:00am-12:00pm.***

***Watson 104***

Refreshments at 10:45am in the Watson lobby